SYSTEM AND METHOD FOR MANAGING RELEASE OF GOODS FOR PACKAGING

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SYSTEM AND METHOD FOR MANAGING RELEASE OF
GOODS FOR PACKAGING

TECHNICAL FIELD

The present disclosure relates in general to methods
and systems for manufacturing goods and, in particular,
to facilities and methods for manufacturing products such
as computer systems according to customer orders.
Specifically, this disclosure relates systems, methods,
and software programs for managing the release of goods
for transport to a packaging or shipping facility after
the goods have been assembled or tested.

BACKGROUND

Many years ago, manufacturers learned that assembly lines can often be used to increase production rates and decrease per-unit production costs. Assembly lines are typically used in a build-to-stock production model, where large quantities of identical products are manufactured in anticipation of forecasted demand.

In many markets, however, predicting customer demand is risky, at best. For example, in the market for computer systems and related items, technological improvements are realized so frequently and component prices change so rapidly that it is difficult to accurately predict how large the market for any particular product will ultimately be. As a result, when manufacturers in industries like information technology utilize the build-to-stock model, those manufacturers frequently find themselves with stocks of manufactured goods that are difficult or impossible to market at a profit.

A contrasting model of production that helps manufacturers avoid the stale-inventory problem is the build-to-order model. According to that model, each product is assembled only after receiving a customer order for that product. In response to receiving the customer order, the manufacturer builds the product according to the order.

For purposes of this document, a product that is manufactured "according to" a customer order is a product that is (1) manufactured in response to a specific order from a customer and (2) manufactured to have the features

specified in that order. With regard to shipping, items
that are shipped "according to" a customer order are
items that are shipped in such a manner that all of the
items arrive at the location specified in the order
5   within the time specified in the order.

        Build-to-order manufacturing systems may be used to
give customers more options with regard to product
configuration and to address the stale inventory problem.
However, build-to-order manufacturing systems have
10   generally been less efficient than build-to-stock
manufacturing systems, with regard to the amount of time
and labor required to fill orders. Production costs are
therefore typically greater in build-to-order
manufacturing systems. In addition, in both types of
15   manufacturing systems, production costs are affected by
the space requirements.

        In highly competitive markets, any significant
reduction in production costs that does not adversely
affect product quality can be an important improvement.
20   As recognized by the present disclosure, a need therefore
exists for a way to reduce space, time, and/or labor
requirements in build-to-order manufacturing facilities.

SUMMARY

The present disclosure relates to a system, a method, and software for managing the release of assembled products for transport to packaging facilities of a factory. In an example embodiment, the products are individually identified products which are manufactured in response to customer orders in a factory that includes pre-packaging facilities and packaging facilities. Components are converted into completed products in the pre-packaging facilities, and the completed products are packaged in the packaging facilities. For example, the pre-packaging facilities may include assembling facilities and testing facilities.

An order management system associates substantially each individually identified product with a customer order. Product release logic in the order management system accumulates the individually identified products in the pre-packaging facilities. The product release logic releases the individually identified products for transport from the pre-packaging facilities to the packaging facilities only after determining that substantially all of the individually identified products for a customer order have been completed.

When the products are released, one or more pick reports may be produced to identify the products to be released from the pre-packaging facilities. Personnel may then retrieve the products for transport to the packaging facilities, based on the pick reports. Additional functionality, such as product location

reports, productivity reports, means for preventing
products from being released, etc., may also be provided.

BRIEF DESCRIPTION OF THE DRAWINGS

    The present disclosure and its numerous objects, features, and advantages may be better understood by reference to the following description of an example

5 embodiment and the accompanying drawings, in which:

    FIGURE 1 presents a block diagram of a prior factory for producing products such as computer systems in a build-to-order fashion;

    FIGURE 2 is a block diagram of an example embodiment

10 of a factory for producing products according to the present disclosure;

    FIGURE 3 is a block diagram depicting an example order management system and related systems for the factory depicted in FIGURE 2;

15   FIGURE 4 presents a flowchart of an example process for releasing goods for transport to packaging facilities;

    FIGURE 5 presents an example pick report; and

    FIGURE 6 is a flow diagram for products and

20 information in the factory of FIGURE 2.

DETAILED DESCRIPTION

    FIGURE 1 depicts a prior art factory 8 for building
products according to customer orders. This particular
factory 8 is designed to produce customized computer
5   systems, where each computer features the specific
hardware components that a customer has specified in a
customer order. For example, the computers may be
assembled from components such as various types of
motherboards, central processing units (CPUs), video
10 cards, network cards, hard disk drives, floppy disk
drives, CD-ROM drives, memory, chassis, etc.

    Factory 8 includes kitting facilities 10, and when a
customer order is released for production, the hardware
components required for the computer systems in the
15 customer order are collected together to form respective
kits. Each kit of components is transported to build
facilities 14, where the components are assembled to form
a computer system. The computer system is then
transported to burn facilities 16, where software is
20 loaded onto the system and various system tests are
performed. Many computers may undergo testing
concurrently in burn facilities 16, and workers in burn
facilities 16 monitor the systems under test for test
completion. If a computer does not pass the tests (i.e.,
25 does not test good), the worker may transport the
computer to an electromechanical repair (EMR) station for
repairs. After repair, the computer may be returned to
burn facilities 16 to be re-tested. When a worker
detects that a computer has passed testing, the worker
30 retrieves the system from burn facilities 16 and

transports the system to packaging facilities 20, where
the system is boxed.

For the purposes of this document, a product is
considered completed once it is ready to be packaged.
5 For example, in factory 8, once a computer has been
assembled, repaired if necessary, and tested good, the
computer is considered completed. By contrast, an order
is considered completed once all products required for
that order have been completed. Also, kitting facilities
10 10, build facilities 14, and burn facilities 16 may be
referred to collectively as pre-packaging facilities 26.

Factory 8 also includes accumulation space 22, which
is used to store boxed systems for incomplete orders.
Specifically, customer orders frequently call for
15 multiple computer systems, and all of the systems
typically are not completed simultaneously. For example,
if a customer order includes ninety computers, some of
the computers may have been completed, boxed, and
transported to accumulation space 22, while others may
20 still be in burn facilities 16, build facilities 14,
kitting facilities 12, the EMR station, or not even
kitted yet. Accumulation space 22 is used to store the
systems that have been completed and packaged while the
remaining systems are still in process.

25 Furthermore, factory 8 may be working concurrently
on numerous different orders for numerous different
customers, with each order calling for numerous computer
systems. In such a case, one or more pallets for each
order will be placed in accumulation space 22, to hold
30 the packaged systems coming from packaging facilities 20

while the remaining systems for each order are being
completed and boxed. Accumulation space 22 therefore
consumes a substantial amount of space in factory 8.

    Once all of the computers for a customer order have
5   been boxed and transported to accumulation space 22, the
pallets with those computers are then moved from
accumulation space 22 to shipping facilities 24, to be
shipped in a group to a remote destination, such as a
customer site. The customer order may also include
10 associated articles, such as speakers, printers, docking
stations for portable computers (e.g., advanced port
replicators (APRs)), monitors, etc., and those articles
may also be shipped from the factory with the computers.

    Thus, in factory 8, orders are released for
15 production to kitting facilities 10, and assembled
products are transported from build facilities 14 to burn
facilities 16 as each system is assembled. Completed
products are then transported from burn facilities 16 to
packaging facilities 20 as each system is completed, and
20 packaged products are transported from packaging
facilities 20 to accumulation space 22 as each product is
packaged. Once all of the packaged products for an order
have been moved to accumulation space 22, those packaged
products are then transported as a group from
25 accumulation space 22 to shipping facilities 24.

    Referring now to FIGURE 2, there is illustrated a
high-level block diagram of an example factory 28 for
manufacturing products according to the present
invention. In the example embodiment, factory 28 is used
30 to manufacture information handling systems, such as

personal computers, servers, routers, or any other
instrumentality or aggregate of instrumentalities
primarily designed to compute, classify, process,
transmit, receive, retrieve, originate, switch, store,

5   display, manifest, detect, record, reproduce, handle or
utilize any form of information, intelligence or data for
business, scientific, control or other purposes. Each
information handling system is individually identified in
factory 28 with a unique identifier, such as a serial

10 number, a service tag number, or a tracking code.

      Factory 28 includes pre-packaging facilities 33,
packaging facilities 44, and shipping facilities 46. The
products are built and tested in the pre-packaging
facilities 33. In addition, as described below, rather

15 than accumulating completed systems after those systems
have been packaged, factory 28 accumulates completed
systems in pre-packaging facilities 33.

      Specifically, referring now also to FIGURE 3, an
order management system 60 tracks order status and

20 releases accumulated products from pre-packaging
facilities 33 for transport to packaging facilities 44
after all of the systems for a particular order have been
completed. Order management system 60 may also be
referred to as a Burn Rack Order Management System

25 (BROMS) 60. In the example embodiment, BROMS 60 is
distributed across and resides primarily on two data
processing systems, a BROMS application server 30 and a
BROMS database server 31. In addition, one or more
additional data processing systems (e.g., a BROMS

workstation 35) provide for user interaction with BROMS
60, for example via a Web browser program.

   In the example embodiment, the hardware in each of
those data processing systems includes one or more CPUs
5 32, random access memory (RAM) 34, ROM 36, input and
output adapters 41, a network interface 44, and one or
more system buses interconnecting the above components.
Input and output adapters 41 receive data from input
devices such as a keyboard and a pointing device and
10 provide output via devices such as video displays.

   As described below, BROMS 60 includes various
components for providing advantageous functionality, such
as product release logic 62, status report logic 64,
product hold logic 66, and location report logic 68. In
15 the example embodiment, those components are implemented
as software which generally resides on disk drives and is
loaded into RAM for execution by CPUs as necessary to
manage various operations in factory 28. For example, as
illustrated in FIGURE 3, disk drive 38 in BROMS
20 application server 30 contains the software components
for product release logic 62, status report logic 64,
product hold logic 66, and location report logic 68.
Similarly, a disk drive in BROMS database server contains
a product completion database 74, which stores
25 information such as order numbers, the quantity of
products required for each order number, a unique
identifier for each product being manufactured, etc.

   Each data processing system in BROMS 60 communicates
with various other systems or subsystems through network
30 interfaces, such as network interface 44. For example,

BROMS 60 receives product location information from a
Work-in-process Tracking Control System (WTCS) database
48, product component and configuration information from
a bar file 50, product-completion status information from
5   a Burn Rack Monitor (BRM) database 52, and product
location information from a wireless input device 40
(shown in FIGURE 2), via an antenna 42 and RF middleware
54. The various components described above may be
referred to collectively as a manufacturing management
10   system 63.

       With reference now to FIGURE 4, in operation,
product assembly begins in factory 28 with manufacturing
management system 63 printing of a bill of materials for
a particular product for a particular customer order, as
15   illustrated at block 202. The bill of materials, which
may also be referred to as a traveler, prints on a
traveler printer 32 in kitting facilities 30.
Manufacturing management system 63 then updates WTCS
database 48 to indicate that the particular product has
20   been released for assembly, as indicated at block 204.
As indicated by the arrow returning to block 202 from
block 204, additional travelers may then be printed for
additional products, even though operations such as
kitting, assembly, etc. may not have been completed yet
25   for the first product.

       After the traveler prints, components needed to
assemble the product according to the customer order are
collected into a kit, as depicted at block 206. As shown
at block 210, after the kit of components is complete,
30   WTCS database 48 is updated again. Then, the kit is

transported to build facilities 34, and WTCS database 48
is again updated to reflect the new location of the kit,
as indicated at blocks 212 and 214. The product is then
assembled, as depicted at block 216. WTCS database 48 is

5   then updated with the new product status, as depicted at
block 220. As shown at block 222, the assembled product
is then transported to testing/burn facilities 36.

A worker in testing/burn facilities 36 then uses a
wireless input device 40 to scan the product into BROMS

10   60. For example, wireless input device 40 may be a
barcode scanner that uses radio frequency (RF)
transmissions to communicate with antenna 42, and BROMS
60 may receive the data from wireless input device 40 via
antenna 42 and RF middleware 54. After the product is

15   scanned into BROMS 60, software may be loaded onto the
product in accordance with the customer order, and BROMS
60 then monitors the performance of tests executed on the
product, as indicated at block 225. As shown at block
226, when the software installation and testing

20   procedures (i.e. the burn process) is completed, BROMS 60
automatically updates product completion database 74
accordingly, as indicated at blocks 226 and 228.

As shown at block 230, BROMS 60 then automatically
determines whether the order is now complete. For

25   example, BROMS 60 may determine that the order is
complete if the product that just completed the burn
process was the final product required to fill a customer
order. If the order is not complete, the product release
process ends without releasing any products. Instead,

30   BROMS 60 updates BROMS database 74 to show that the order

did not meet the release criteria, as indicated at block
237, and BROMS 60 then periodically re-checks the order
status, as indicated by the arrow returning to block 230.

     However, if the order is complete, BROMS 60 next
5   determines whether all of the products for the complete
order are in a known location, as shown at block 232.
For example, BROMS 60 may test to determine whether all
of the systems are in testing/burn facilities 36. If the
location of all systems is not known, BROMS database 74
10   is updated and the process returns to block 230 without
releasing any products, as described above.

     Otherwise, BROMS 60 determines whether all
accessories for the order are available, as shown at
block 234. For instance, in addition to computer
15   systems, the order may call for pointing devices,
monitors, or other accessories, and BROMS 60 may query
WTCS database 48 to determine whether all of the required
accessories are available. If all of the accessories are
not available, BROMS database 74 is updated and the
20   process returns to block 230 without releasing any
products, as described above. Otherwise, as shown at
block 236, BROMS 60 determines whether the order has been
placed on hold.

     For example, product hold logic 66 in BROMS 60
25   supports numerous different types of hold requests which
provide for more efficient operation of factory 28. For
instance, a factory manager may place a hold on a
specific product by providing a unique identifier such as
a service tag number or serial number for that product.
30   Similarly, the factory manager may place all products for

a particular order on hold by specifying the appropriate
order number. BROMS 60 would then automatically identify
the products involved in that order and prevent those
products from being released from testing/burn facilities
5   36, even though all products required for that order may
be complete. The plant operator may also place products
on hold by specifying a particular component to be held,
and BROMS 60 would then automatically identify all
products that contain the specified component, to prevent
10   those products from being released to packaging. Also,
the product manager can specify a product model to be
held. For example, the manager may place a hold on all
products with the model specification Poweredge 1500.
BROMS 60 would then automatically prevent all products
15   having that model from being released to packaging. A
product may also be held in response to cancellation of a
customer order or a stop shipment request being placed on
a customer order.

        If any of the products for the order are on hold,
20   BROMS database 74 is updated and the process returns to
block 230 without releasing any products, as described
above. Otherwise, the process passes from block 236 to
block 238, and BROMS 60 releases the order for transport
to packaging facilities 44 by printing one or more pick
25   reports which identify the specific products to be
retrieved from testing/burn facilities 36. The pick
reports may also be known as pick tickets, and the pick
tickets are printed on a pick ticket printer 38 within
testing/burn facilities 36.

Referring now to FIGURE 5, an example pick ticket
includes four unit identifiers which specify the products
to be retrieved, and four respective unit locations which
specify the locations within testing/burn facilities 36
5   where the specified products can be found. Specifically,
in the example embodiment, testing/burn facilities 36
include numerous burn racks which accommodate the
products that are receiving software and being tested.
The burn racks provide a matrix of slots arranged in rows
10   and columns, and various subsets of columns may be
referred to as aisles. The unit locations in the pick
ticket of FIGURE 5 identify the slots within the burn
racks which contain the products to be retrieved for
transport to packaging facilities 44. By providing pick
15   reports that specify precisely which products need to be
retrieved for transport to packaging facilities 44 and
precisely which locations contain those products, BROMS
reduces the amount of labor required, compared to
factories in which workers look for completed systems to
20   retrieve without explicit directions.

If a customer order includes more than four
products, multiple pick tickets will be printed in
sequence, so that the whole order is released for
transport to packaging at substantially the same time.
25   Thus, unlike in prior factories, in factory 28 products
are transported from the pre-packaging facilities to the
packaging facilities on the basis of completed orders,
rather than on the basis of completed systems. BROMS is
also provided with a pause button, which may be pressed
30   to temporarily stop all pick tickets from being printed.

With reference to block 240 of FIGURE 4, after the
pick ticket or tickets are printed, workers retrieve the
identified products and scan the products out of the
BROMS 60. For instance, a worker may scan a barcode on
5   each product that is being retrieved. In addition, the
associate manually updates WTCS database 48, and the
products are then transported to packaging facilities 44,
as indicated at blocks 242 and 244, respectively.

There, the products are packaged in preparation for
10   shipment. For example, a vacuhoist may be used to lift
each product into its own box. Accessories for the
product may also be placed into the box, and then the box
may be sealed. As shown at block 246, the product may
then be transported to shipping facilities 46 for
15   shipment with other products in the order to the
customer. The process for releasing that specific order
then ends. However, BROMS 60 also continues to monitor
and process any remaining orders, automatically
identifying and processing completed order as those
20   orders reach completion, as described above.

Referring again to block 238, in BROMS 60, product
release logic 62 determines when an order will be
released from burn facilities 36, as described above. In
addition, product release logic 62 optimizes the release
25   process to minimize the amount of labor required to
retrieve the products for transport to packaging
facilities 44. For instance, in the example factory, the
burn racks have four rows, and carts with four rows and
the capacity to carry one product in each row are used to
30   transport products from pre-packaging facilities 33 to

packaging facilities 44. When printing pick reports,
product release logic 62 generally selects four products
in four different rows of the burn rack, so that each of
those products may be slid from its burn slot to the cart

5   without any manual lifting or lowering. In addition,
product release logic 62 provides for a steady flow of
products for each order, so that workers in packaging
facilities 44 and shipping facilities 46 see the packages
for each order in a substantially continuous flow, which

10 allows those workers to do their jobs more efficiently.
Additionally, the logic of BROMS can be set to determine
how many orders will be released in parallel and what
order sizes should be accumulated.

      In addition to the control capability described

15 above, BROMS 60 also provides detailed order status
monitoring and reporting capabilities. For example,
BROMS 60 includes a burn rack utilization monitor 72 that
tracks which slots in the burn rack are occupied or
vacant and produces reports describing the vacant

20 capacity in the burn racks of testing/burn facilities 36.
A production manager may use the reports of vacant
capacity to assign priority to different orders, thereby
causing burn slots to be made available as necessary for
a desired production sequence. For example, the

25 production manager may use the capacity reports to
prevent undesirable situations such as deadlock, in which
no orders can be completed because no vacant space is
available to accommodate products needed to complete
pending orders.

Location report logic 68 provides location reports
which identify a location for one or more products based
on at least one attribute of those products. For
example, the product attribute may be a unique identifier
5   for a specific product, an order number involving one or
more products, an identifier for a component included in
one or more products, or a product model identifier.
When an individual inputs one of those kinds of
attributes, BROMS 60 automatically determines and
10   displays the location of all corresponding products, such
as the location of the specific product, of all products
required for a particular order, of all products
including a specified component, or of all products with
a specified product model.

15   Status report logic 64 produces status reports which
list all orders that are complete or nearly complete.
The status reports may be used in packaging facilities 44
to help predict requirements for resources such as
packaging material and manpower. The users of the status
20   reports will predict demand for the packaging department,
which will allow proper utilization of resources in the
packaging area.

Some status reports, known as EMR reports, also
cross-reference order-status information from product
25   completion database 74, WTCS database 48, and BRM
database 52. Specifically, the EMR reports notify
individuals such as production managers about which
orders are nearing completion and which of those orders
have products in EMR. Furthermore, the reports provide
30   the unique location and unique identifier for each

product in EMR. The production manager may then instruct
EMR technicians to increase the priority for repairing
the specific product or products needed to complete a
nearly complete order.

5   For example the report may show that an order
requires one hundred systems, that ninety-nine of those
systems have been completed, and that one of the systems
failed testing and is in EMR. The production manager
could then instruct the EMR technicians to repair the
10   faulty system immediately. The EMR reports therefore
allow the production manager to force resolution of
problems earlier and parallel to systems under test. For
instance, if an order is nearing completion, the manager
can increase the priority for repairing specific products
15   in EMR, so that those repairs can be completed by the
time any remaining products are built and tested.

In addition, BROMS 60 tracks productivity for each
worker in burn facilities 16 (i.e., for each burn
associate), keeping track of how many products each burn
20   associate has retrieved for transport to packaging, what
kind of system each burn associate has pulled, etc.
BROMS 60 also produces productivity reports that document
the productivity of each burn associate and indicate
whether any burn associate has been "cherry picking," for
25   example by only servicing pick tickets for certain kinds
of systems or for systems in certain parts of the burn
rack. To facilitate productivity tracking, each wireless
input device 40 (also known as a scanner 40) may be
checked out to one burn associate, and when the scanners
30   are used to scan products into and out of burn facilities

16, those activities may be attributed to the respective
burn associates. Alternatively, the burn associates may
wear employee badges, and each burn associate may be
required to scan his or her badge, the product track

5 code, and the burn location with scanner 40 when scanning
products into burn. When a product completes burn, the
associate may then be required to scan his or her badge
and the product track code using a different scanner to
scan products out of burn, to facilitate a count of

10 systems unloaded from burn.

    Referring now to FIGURE 6, the flow of components,
products, and information within factory 28 is summarized
in a flow diagram. The physical flow of components and
products through the different areas of factory 28 is

15 represented by the thick arrows at the top of the diagram
between the boxes for Traveler Pull, Kitting, Build, and
Burn, as well as by the thick arrows between the boxes
for Retrieval to Packaging, Packaging, and Shipping. As
indicated by the arrows flowing down from the boxes at

20 the top of the diagram for Burn, Accumulate in Burn, and
Retrieval to Packaging, many operations must be performed
in burn facilities 36 and many conditions must be
satisfied before products are released from burn
facilities 36 for transport to packaging facilities 44.

25 The dashed lines and associated dashed circles A, B, C,
and D summarize the content of the communications or
information that passes between the various components of
manufacturing management system 63, as further explained
in the box labeled "Key to Communications Content."

In conclusion, as will be evident from the above
description, factory 28 enjoys numerous advantages,
relative to prior factories. For example, less handling
of products is required, as products do not have to be
5   parked in an accumulation space after they are boxed, and
then moved from the accumulation space to the shipping
facilities. Instead, the products may be transported
directly from packaging facilities 44 to shipping
facilities 46.

10   Furthermore, packaged products typically occupy more
space than unpackaged products. In prior factories,
however, products are typically accumulated (e.g., on
pallets or in an automated storage and retrieval system
(ASRS)) after they have been packaged. By contrast,
15   factory 28 accumulates products before they are packaged.
This approach is therefore more space efficient and/or
less costly than approaches used in prior factories.

Moreover, by closely tracking product locations
throughout the assembling, testing, and accumulation
20   operations, BROMS 60 makes it easier to place holds on
products, based on a variety of different criteria, and
to locate specific products. By contrast, prior systems
which tracked product location less closely required
workers to manually examine bills of materials for
25   numerous systems to identify particular systems of
interest, such as systems including a specified component
or products for a specified order.

For example, to monitor product quality, a
manufacturer may desire to test random systems subsequent
30   to the standard testing/burn operations. Such a quality

assurance test may be referred to as an out of box

experience (OBE). Whereas prior factories required boxes

to be unsealed and opened so that post-completion testing

could be performed, BROMS 60 allows products to be

5   located in the pre-packaging facilities and tested before

they are boxed.

     Although the present invention has been described

with reference to an example embodiment, those with

ordinary skill in the art will understand that numerous

10   variations of the example embodiment could be practiced

without departing from the scope and spirit of the

present invention. For example, a number of

determinations are described above as being made by

manufacturing management system 63. As will be evident

15   to those of ordinary skill in the art, most or all of

those determinations are made automatically and with

reference to databases that reflect the current state of

the production environment. Most or all of those

databases are preferably within manufacturing management

20   system 63, but some may alternatively be maintained

externally.

     Also, the modules and components depicted in the

example embodiment represent functional elements that are

reasonably self-contained so that each can be designed,

25   constructed, or updated substantially independently of

the others. In alternative embodiments, however, it

should be understood that the components may be

implemented as hardware, software, or combinations of

hardware and software for providing the functionality

30   described and illustrated herein. In alternative

embodiments, data processing systems incorporating the
invention may include personal computers, mini computers,
mainframe computers, distributed computing systems, and
other suitable devices. Additionally, in alternative
5   embodiments, some of the components of the order
management system could reside on different data
processing systems, or all of the components could reside
on the same hardware.

    Alternative embodiments of the invention also
10 include computer-usable media encoding logic such as
computer instructions for performing the operations of
the invention. Such computer-usable media may include,
without limitation, storage media such as floppy disks,
hard disks, CD-ROMs, read-only memory, and random access
15 memory; as well as communications media such wires,
optical fibers, microwaves, radio waves, and other
electromagnetic and/or optical carriers. The control
logic may also be referred to as a program product.

    Many other aspects of the example embodiment may
20 also be changed in alternative embodiments without
departing from the scope and spirit of the invention.
The scope of the invention is therefore not limited to
the particulars of the illustrated embodiments or
implementations but is defined by the appended claims.

25